Coyote Lure Ingredients

What Determines Success?

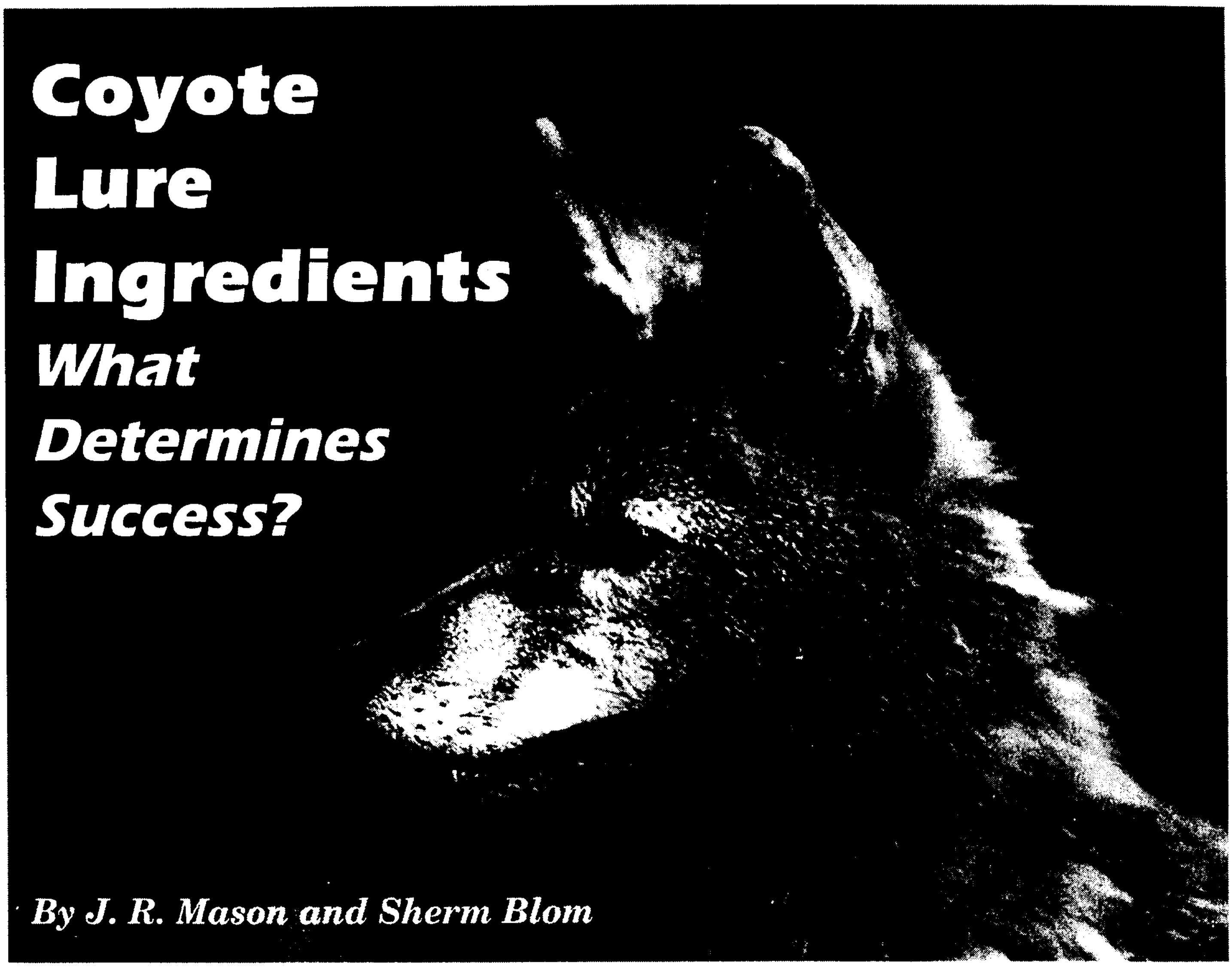

Photo by Richard Rife

By J. R. Mason and Sherm Blom

Effective lures are essential for coyote trapping success. Nearly every trapper has a favorite brand or concoction, and those involved in lure preparation treat ingredients as carefully guarded secrets. In this respect, lure-making and perfume manufacture are alike; both have an extensive and colorful vocabulary, and until recently, both were art more than science. The vocabulary remains, but today, investigators are systematically examining chemical attractants (lures), chemical repellents, and the sensory mechanisms that underlie their effects. In general, and in the discussion below, lures are chemical signals that attract animals because of their territorial, social, or sexual significance, or because they signal food. But we believe (and most of the data suggests) that the same sets of compounds account for the attractiveness of all lures, regardless of their origin or putative biological significance. Nearly all lure formulations are comprised of chemicals from one or more of the following five groups:

(1) Short-chain fatty acids. These 'cheesy', 'fishy', or 'sweaty' odors are the backbone of many effective lures.

(2) Volatile sulfides. These are the common and the powerful odors in musks, asafetida, urines, and garlic. Mammals are able to detect extremely low concentrations of these substances, and thresholds are often in the parts per million or parts per billion range. Not surprisingly, sulfides are attractive over long distances.

(3) Aldehydes. These are found in preparations from glands and urines, usually in small quantities. Aldehydes are unique in that they readily oxidize to become acids. These acids also can be attractive, though their odor quality will be different from the parent aldehyde.

(4) Phenols. These are the characteristic odors of beaver castor and smoked meats or fish. Phenols also contribute to the odor of fish, cheeses, and urines.

(5) Ketones. These are found in glandular preparations, urines, and foods. Ketones are persistent odors and can also act as fixatives (i.e., substances that enhance the persistence of other odors).

Table 1 provides a list of coyote lure ingredients.

Sensory Mechanisms

Taste. Although the most obvious sensory characteristic of lure formulations is their odor, attractive tastes can significantly improve performance. Like dogs, coyotes prefer sugar, and the use of sucrose or fructose at concentrations above 1.0% (weight/weight) greatly increases mouthing, licking, biting, and chewing. In tests with captive coyotes, sugar is attractive year-round to young and old, and males and females. Glycerin (glycerol), and propylene glycol also are sweet. These chemicals usually are included in lures to prevent freezing and dessication, but they also can be used as

A coyote makes his living with his nose, using it both offensively and defensively. Knowing how it works can help a trapper choose lures that more effectively capitalize on the coyote's behavior.

taste attractants. Preference for sweet is species-selective, because strict carnivores like cats, mink, ferrets, and otters are not attracted to this taste quality. Strict carnivores probably cannot taste sugar at all; the sweet taste receptor has been modified to detect amino acids.

Coyotes are not attracted by 'protein' tastes (e.g., proline, monosodium glutamate), although they are attracted by the odor of various meat extracts (see below). Coyotes also are indifferent to salt (like most animals with large amounts of meat in their diets) and sour tastes. Like preference for sweet, indifference to sour is somewhat species-selective. Cats, mink, and otters prefer diets that are acidified. Consequently, phosphoric acid is a common ingredient in commercial cat and mink diets.

Odor

Odor perception is complex. In mammals, it involves several different sensory systems that are as different in function as hearing is from vision. The most important of these systems are the sense of smell (olfaction), Jacobsen's organ (vomeronasal chemoreception) and trigeminal chemoreception. Olfaction is designed to detect volatile substances at a distance. Less volatile chemicals stimulate Jacobsen's organ. Vomeronasal cues cannot be detected at a distance and usually require physical contact for perception. Because they are not especially volatile, vomeronasal cues persist in the environment for long periods of time and communicate information about sex, reproductive status, dominance, and individual identity. All known mammalian pheromones are vomeronasal stimuli. Finally, irritants like ammonia formed by bacterial degradation, are present in old or poorly stored lures and urines. These substances are potent stimuli for pain receptors in the eyes, nose, and mouth. Detection thresholds for irritants can be lower than those for olfaction or vomeronasal stimuli, so even small amounts can interfere with effectiveness of odor-based lures. Urines purchased from commercial sources sometimes contain 40% ammonia. Preservatives and/or refrigeration can be used to stop or slow the aging process and delay the formation of irritants (see below).

Lures

Lures are effective because they mimic social, sexual, or territorial signals (so-called semiochemicals), because they suggest the presence of food, or sometimes, because simply they are unfamiliar to the responding animal. Some lures present both kinds of information (e.g., lures based on fish or fish oil). For this reason, the same lure may elicit different behaviors depending on the social, sexual, and nutritional status of the responding coyote (Table 2). Lunar phase, season, temperature, and the availability of alternative foods also impact lure success.

Semiochemicals. Broadly speaking, these are cues that emanate from organs or fluids (e.g., urines) of coyotes, other predators, or potential prey that convey social, sexual, or territorial information. Common organs used for semiochemical communication include perineal glands, as well as glands from the ears, legs, and foot pads. Stomachs, urinary bladders, gall bladders, and livers also contain semiochemical information. For use in

Table 1. Common ingredients in lure formulations, methods of preparation, and frequent applications.

Ingredient	Source	Preparation	Use
Muskrat glands/musk	2 small glands on either side of vent of males during spring breeding season.	Fresh ground; preserved; tinctured.	Acids in musk are attractive to coyotes.
Beaver castor	2 large flat glands on each side of vent of both males and females.	Fresh ground; preserved; dried; rasped to a powder; tinctured (castorium).	Phenols attractive to coyotes; serve to fix, preserve other ingredients in lures.
Beaver sac oil	2 long oval-shaped, whitish glands found next to the castors.	Fresh ground; preserved; oil squeezed from glands and glands discarded.	Used alone, or mixed with castors and used as a fixative.
Mink glands/musk	2 glands found on either side of vent of males in breeding season.	Ground fresh; preserved; tinctured.	Contains sulfides, attractive to coyotes.
Glands/Urines from canids/felids	Fox, bobcat, dog, badger, etc.	Ground fresh, or preserved or rotted.	Curiosity lures.
Asafetida	Plant.	Gum, powdered, tinctured.	Contains sulfides, attractive to coyotes.
Garlic & onion	Plants.	Powders, salts, oils.	Contains sulfides, attractive to coyotes.
Valerian root	Plant.	Powder, oil, extract or salt (i.e., zinc valerate).	Valeric acid, attractive to coyotes.
Rue oil	Plant.	Oil; 3-5 drops per pint.	Methyl ketones impart a cheesy odor.
Skunk musk	2 glands found on either side of vent in males.	Oil; 3-5 drops/pint used as component; 6-10 drops/pint as dominant odor.	Powerful sulfide (mercaptan) odor attractive to coyotes.
Orris root	Plant.	Powder, oil, tincture; 1/2 tsp of oil/tincture or 1/8 tsp to powder/pint.	Fixative, contains acids attractive to coyotes.
Oakmoss	Plant.	Resin, tincture; 3-5 drops resin, or 1/4 tsp of tincture/pint.	Fixative.
Phenyl acetic acid	Synthetic chemical.	Tincture or crystals.	Honey-like odor; also found in urines and scent glands.
Cilantro oil (coriander leaf oil)	Plant.	Oil; 2-4 drops/pint.	Aldehydes attractive to coyotes.
Anise oil	Plant.	Oil; 3-5 drops/pint.	Licorice odor.

lures, tissues often are fermented (rotted) by naturally present bacteria. Metabolic by-products of fermentation include the sulfides, ketones, and volatile fatty acids that are characteristic of many effective lures. Depending on the genera and species of bacteria present, fermentation of the same semiochemical substrate can produce mixtures that elicit urination, digging, rolling, pulling, or carrying. Most likely, the fermentation used to produce lures is an exaggeration of the normal fermentation involved in the production of semiochemicals by coyotes.

A common belief is that mixtures are more attractive than their individual components. This is often true, although there are notable exceptions. Isolating and concentrating key ingredients can produce lures that are more attractive than the parent mixtures. For example, the acidic and neutral fractions of coyote urine are nearly three times more attractive than whole urine. In terms of specific compounds, trimethylamine (TMA), and nonanal and valeric acids are the most attractive components in whole urine. TMA is an example of a chemical with both semiochemical and food characteristics. It is present in the anal sacs of many canids, and it also contributes to the odor of fish and decaying meat. However, it has a boiling point of about 36 degrees F, so it evaporates rapidly in its' free state. When a weak acid such as valeric or decanoic acid is added to TMA, a stable salt is formed that releases TMA slowly. For this reason, both trimethylammonium valerate (TMAV) and trimethylammonium decanoate (TMAD) are long-lasting attractants to coyotes.

The importance of fermentation to the production of coyote semiochemicals led to the use of fermented egg product (FEP) as a coyote lure by the U. S. Fish and Wildlife Service. FEP was originally developed as a fly attractant, and it contained many of the sulfides and short-chain fatty acids present in coyote chemical signals. When production of FEP was discontinued in 1975, synthetic fermented egg (SFE) was developed. SFE was superior to FEP as an attractant for coyotes, and because it contained fewer ingredients, it was easier to formulate. For these reasons, during the 1970's and 1980's, SFE served as a standard attractant against which other lures were compared. Fatty acid scent (FAS) is another derivative of FEP, and is comprised of 10 fatty acids. Because FAS is simpler to formulate than SFE, and because it is as attractive to coyotes as SFE in scent post tests, FAS is now the standard attractant used in coyote abundance surveys. FAS is a superior warm weather attractant for use with M-44 cyanide ejectors, and it tends to be more effective than other popular formulations (e.g., W-U lure, Carman's Distant Canine Call, Smoked Fish Lure, Beef Liver). FAS is infrequently used, however, even though a diluted ready-to-use formulation is commercially available from the Pocatello Supply Depot. Another related but rarely used blend of fatty acids is synthetic monkey pheromone (VFA or DRC-6220). VFA also is available from the Pocatello Supply Depot, and it remains the only pheromone-type lure for coyote trapping. Other synthetic lures include W-U and TMAD. Both of these lures were developed by the University of California and the Agricultural Research Service of the USDA, but are no longer commercially available.

Foods

Studies of coyote food habits mostly

Table 2; Average investigation times (seconds) of captive coyotes to nine attractants. (From: Phillips, R. L., F. S. Blom, and R. M. Engeman, 1990. Responses of captive coyotes to chemical attractants. Proceedings of the Vertebrate Pest Conference 15:285-289.

Attractants	Breeding Season	Rearing Season	Pup Dispersal Season	Total Response Time
W-U (TMAD and sulfides)	277.6	394.4	473.4	1145.4
FAS (Fatty Acid Scent)	219.0	424.7	496.7	1140.4
Synthetic Monkey Pheromone (DRC-6220)	182.8	133.4	355.9	672.1
Trimethyl Ammonium Decanoate (TMAD)	280.9	167.0	217.2	665.1
Artificial Smoked Fish	140.7	210.5	213.2	564.4
SFE (Synthetic Fermented Egg)	190.6	160.8	179.5	530.9
Decanoic Acid	175.6	199.3	91.2	466.1
Yeast Autolysate	40.1	104.6	71.6	216.3
Artificial Beef Liver	58.6	104.7	19.4	182.7

focus on consumption during winter and early spring. Diets during the cold weather months consist almost exclusively of vertebrate prey, including big game and livestock, carrion, rabbits, and rodents. Despite claims to the contrary, big game can dominate diets. For example, coyotes in southeastern Idaho subsist on mule deer, and to a lesser extent, livestock. Voles, rabbits, and insects make up less than 10% of the diet.

During warm weather months, the percentage of vertebrate foods in coyote diets is reduced. Insects and fruits can predominate (probably because of ready availability), and rotted meat-based lure formulations become less effective. During this time of year, coyotes generally prefer to kill live prey and ingest fresh meat. The heart and liver of prey are preferred foods. A collaboration between the University of California and the U.S.D.A. Agricultural Research Service showed that thiazoles (nitrogen-containing chemicals) were principle attractants in sheep liver. Extracts of pork, sheep, and beef liver were compared at various concentrations. There was a slight preference for pork liver, but coyotes responded well to all three liver types during spring and summer months when conventional lures are less attractive. When fruits dominate coyote diets, selection is correlated with sugar content, and sweetness probably guides choice. Abundance can be more important than calories. Mesquite beans have little nutritional value, but coyotes feed almost exclusively on them when they are available. Why coyotes (and other wildlife) make 'poor' food choices remains unknown.

Among lures prepared from meat, fish and fish oils are particularly effective. Fish oil mixed with SFE is even more attractive, perhaps because trimethylamine is found in both. In general, any rendered meat can be attractive. Though proportions may vary from one formulation to the next, the same sulfides and volatile fatty acids probably account for the attractiveness of all lures.

Preservatives, Fixatives, Thickening Agents

All lures can benefit from the use of preservatives. Two common preservatives are sodium benzoate and methyl paraben. Both of these substances can be added to lures to slow degradation or stop fermentation.Two tablespoons of sodium benzoate added to a gallon of urine or one teaspoon to a pint of paste lure retards the formation of ammonia and other irritant chemicals that diminish attractiveness. Glycerin (glycerol) also can act as a preservative when added at the rate of one pint/gallon or four ounces per pint. These substances prevent freezing in winter, dessication in summer, and can extend the life of a scent in the field. Propylene glycol or a mixture of glycerin and propylene glycol in equal amounts can be substituted for glycerin alone to prevent the growth of mold.

An alternative to preservatives is freezing. Urines can be frozen without affecting their general attractiveness. Neither freezing nor the use of preservatives; however, can maintain certain chemical nuances. Estrous urines, for example, are more effective than plain urines when fresh, but the chemicals responsible for enhanced attractiveness disappear rapidly. Even the most carefully preserved commercial estrous urine is no more effective than plain urine.

Castors, anise oil, and phenyl acetic acid are examples of fixatives. These substances amplify and prolong the attractiveness of other substances present in the lure matrix. The sensory mechanisms underlying this effect remain poorly understood. Fixatives are often used as tinctures (alcohol extracts) and in low volume because they have strong odors of their own. Tallow, lard, fat, lanolin and powders prepared from meats, blood, liver, bone and feathers are added to lures as thickening agents and to moderate the strength of other odor. These substances have no preservative or fixative effects, per se.

Conclusions

The basic biology underlying the effectiveness of lures is gradually becoming understood. This permits the systematic formulation of consistently attractive materials. Although much work remains to be done, at least among meat-based lures, glandular products, and urines, the evidence suggests that a few chemicals account for the effectiveness of all formulations, regardless of their source. Variability in response to different lures probably reflects differences in the concentration and balance among these common ingredients, rather than qualitative differences, per se. Whether or not lures based on plant odors follow similar cardinal principles is unclear. The available data suggests that they may. Valeric acid, for example, is present in valerian root, a plant that is widely used in lures. Valeric acid is also present in coyote urine and anal gland secretions. Likewise, androstenone is a mammalian pheromone that is attractive to many species. This chemical also is produced by plants as diverse as oaks (androstenone is present in acorns) and truffles. Androstenone is the cue used by pigs to find the latter. Finally, man-gone (pulegone mercaptan) is both the odor of cat urine and mangoes, the difference in odor quality being solely one of concentration. The development of warm weather lures that incorporate the odors of food plants remains an exciting and virtually unexplored area for the development of new lure combinations.

Suggested Readings

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CORRESPONDENCE COURSE OFFERED

Utah State University has developed a correspondence course that offers two (2) college credits. The course, *Fisheries and Wildlife 481*, is called "Directed Reading in Wildlife Damage Management." The textbook is the 1994 *Proceedings Of the Sixteenth Verebrate Pest Conference*.

If interested, contact the Independent Study Division, UMC 5000, Utah State University, Logan, UT 84322-5000, or call 1-800-233-2137. Ask for registration material for FW 481, "Directed Readings in Wildlife Damage Management." Registration fee is $90, textbook not included.